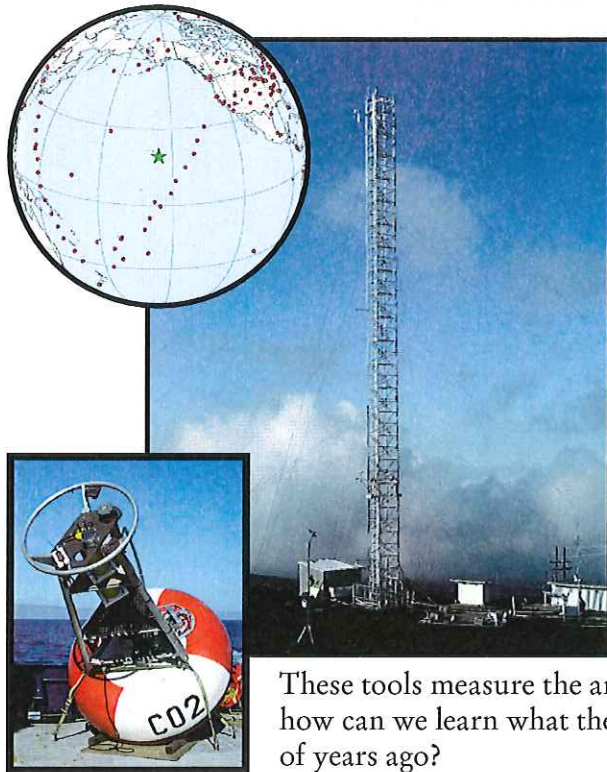


How Do Scientists Know about Carbon in the Atmosphere?



Carbon Dioxide Sensors

It is useful to compare today's atmosphere with Earth's atmosphere in the past. That way, we can study how the atmosphere has changed over time.

Using tools called CO₂ sensors, scientists have measured CO₂ in the atmosphere every day since 1958 from the top of a very tall mountain called Mauna Loa in Hawaii. Located high on a volcano in the Pacific Ocean, as far away as possible from a lot of human activity, the air is ideal for sampling. Starting in 2011, CO₂ is also being regularly measured with sensors at over 100 additional places around the world.

These tools measure the amount of CO₂ in the atmosphere today, but how can we learn what the atmosphere was like thousands or millions of years ago?

Mauna Loa Observatory (above right) is a research station that records CO₂ levels and other data about the atmosphere from the middle of the Pacific Ocean. At left is another kind of CO₂ sensor, which has been placed in the ocean off the coast of California.

Ice Cores

One way scientists measure CO₂ levels in the atmosphere from the past 700,000 years is by studying bubbles of air trapped in layers of ice on Greenland and near the South Pole. In these places, the snow does not melt, but instead, it piles up year after year, and gets pressed into ice. Older layers of ice are buried deeper each year as new layers of ice form near the surface. The deepest layers were frozen very long



How Do Scientists Know about Carbon in the Atmosphere? (continued)

ago. When the ice froze, there were tiny bubbles of air trapped in the ice. These air bubbles are samples of the atmosphere at the time the ice froze. Scientists measure how much CO₂ is in the air bubbles in each layer of ice. Their measurements provide evidence about how levels of CO₂ in the atmosphere have changed over thousands of years. In Greenland, scientists drilled down nearly 2 miles to get data going back 110,000 years ago. Ice core samples from Antarctica gave information going back 750,000 years.



This team of cooperating scientists from France, Russia, and the United States is taking a moment to show off their ice cores in Vostock, Antarctica.

Plant Leaf Stomata

Ice cores can only provide evidence of CO₂ levels going back several hundred thousand years. To learn about much earlier CO₂ levels in the atmosphere—from millions of years ago—scientists use other evidence, including plant fossils. Tiny pores on plant leaves called **stomata** control the amount of CO₂ and water that goes into and out of leaves. Scientists have found that when there is less CO₂ in the atmosphere, most plants have a lot of stomata. Having a lot of stomata means the plant can capture as much CO₂ as possible when there is less CO₂ available. But when there is a lot of CO₂ in the atmosphere, plants don't need as many stomata to collect CO₂, so most plants have fewer stomata. By counting stomata on plant fossils, scientists can figure out what CO₂ levels were like in the atmosphere millions of years ago when the plants were alive.

